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In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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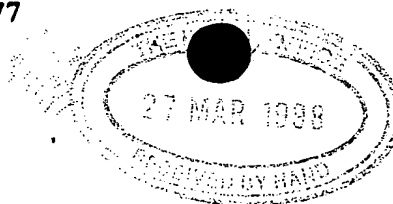
Signed

*Andrew*

Dated

21.1.1999

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P01/7700 25.00 - 9806689.7

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**Request for grant of a patent**

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form))

1. Your reference		P.74514 GCW.CMK	
2. Patent application number (The Patent Office will fill in this part)		27 MAR 1998	9806689.7
3. Full name, address and postcode of the or of each applicant (underline all surnames)		PHARMACIA & UPJOHN S.P.A. Via Robert Koch 1.2 20152 Milan, Italy	
Patents ADP number (if you know it)		Italy	
If the applicant is a corporate body, give the country/state of its incorporation		7100001001	
4. Title of the invention		ACRYLOYL DERIVATIVES ANALOGOUS TO DISTAMYCIN, PROCESS FOR PREPARING THEM, AND THEIR USE AS ANTITUMOUR AND ANTIVIRAL AGENTS.	
5. Name of your agent (if you have one)		J A KEMP & CO	
"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)		14 SOUTH SQUARE GRAY'S INN LONDON WC1R 5LX	
Patents ADP number (if you know it)			
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number	Country	Priority application number (if you know it)	Date of filing (day / month / year)
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application		Date of filing (day / month / year)
8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer "Yes" if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body: See note (d))	Yes		

# Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description 46

Claim(s) 12

Abstract 1

Drawing(s)

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents  
(please specify)

11. I/We request the grant of a patent on the basis of this application

Signature

*JA Kemp*

Date 27 March 1998

12. Name and daytime telephone number of person to contact in the United Kingdom KEEN, Celia Mary  
0171 405 3292

## Warning

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## Notes

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- b) Write your answers in capital letters using black ink or you may type them.
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- d) If you have answered "Yes" Patents Form 7/77 will need to be filed.
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**ACRYLOYL DERIVATIVES ANALOGOUS TO DISTAMYCIN, PROCESS FOR PREPARING THEM, AND THEIR USE AS ANTITUMOR AND ANTIVIRAL AGENTS.**

5 The present invention relates to new peptidic compounds analogous to Distamycin A, to a process for their preparation, to pharmaceutical compositions containing them and to their use as therapeutic agents.

Distamycin A is an antibiotic substance with antiviral and  
10 oncolytic properties, having a polypyrrole framework (Nature 203, 1064 (1964); J. Med. Chem. 32, 774-778 (1989)).

Several analogous to Distamycin A and derivatives thereof are known in the art.

The international patent application WO 97/43258, in the  
15 name of the applicant, discloses acryloyl distamycin derivatives wherein the amidino moiety is replaced by different nitrogen-containing ending groups such as, for instance, cyanamidino, N-methylamidino, ethylguanidino, amido, amidoximo, nitrile and the like.

20 Distamycin derivatives wherein at least one pyrrole ring of the aforementioned polypyrrole framework is substituted by an imidazole or pyrazole ring are also reported in the literature.

See, for a general reference, Anti-Cancer Drug Design 8,  
25 173-192 (1993); J. Am. Chem. Soc. Vol. 114, 5911-5919 (1992); Anti-Cancer Drug Design 6, 501-517 (1991); patent applications EP-A-0246868 and WO 96/05196, both in the name of the applicant.

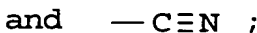
It has now been found that a new class of distamycin  
30 derivatives as defined hereinunder, wherein at least one ring of the polypyrrole framework is other than pyrrole, the formyl group is substituted by an acryloyl moiety and the amidino group is substituted by different nitrogen-containing ending groups, shows valuable biological  
35 properties.

Therefore, the present invention provides compounds which are acryloyl substituted distamycin derivatives of formula



$m$  is 1 or 2;

- 10 R<sub>3</sub> is hydrogen or halogen;



- 15 or hydroxy;

a) at least one of  $R_4$ ,  $R_5$  and  $R_6$  is alkyl;

- 20 polyheterocyclic chain is other than pyrrole; and

25 (I), both separately and in admixture, as well as the

precursors (otherwise known as pro-drugs) of the compounds of formula (I).

In the present description, unless otherwise specified, the term alkyl includes straight or branched alkyl, for instance C<sub>1</sub>-C<sub>4</sub> alkyl such as methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, sec-butyl and tert-butyl; the term halogen includes fluorine, chlorine, bromine and iodine.

Preferably, the alkyl groups are selected from methyl and ethyl and the halogen atoms are selected from fluorine, chlorine or bromine.

Pharmaceutically acceptable salts of the compounds of formula (I) are the salts with pharmaceutically acceptable, inorganic or organic, acids. Examples of inorganic acids are hydrochloric, hydrobromic, sulphuric and nitric acid; examples of organic acids are acetic, propionic, succinic, malonic, citric, tartaric, methanesulfonic and p-toluenesulfonic acid.

As above reported, X and Y are selected, independently for each heterocyclic ring of the polyheterocyclic chain, between N and CH. This means that within the compounds of formula (I) and for different heterocyclic rings, X can be either N as well as CH; the same applies for Y provided that X and Y are not contemporaneously N for a single heterocycle.

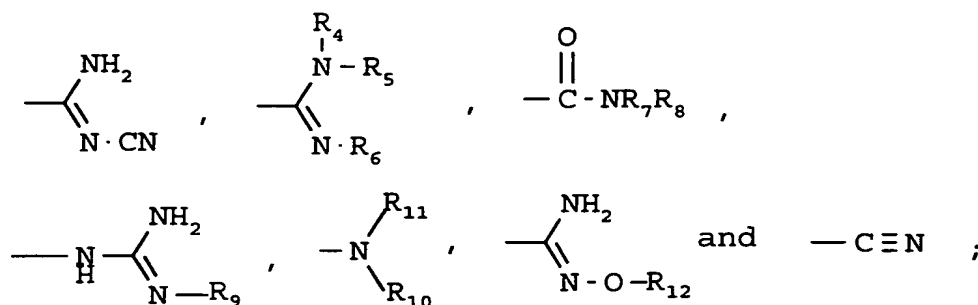
Examples for the said heterocycles are pyrrole, pyrazole and imidazole.

A preferred class of compounds according to the present invention is represented by the compounds of formula (I) wherein R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, R<sub>10</sub>, R<sub>11</sub> and R<sub>12</sub> are, independently from each other, hydrogen, methyl, or ethyl.

Even more preferred are the compounds of formula (I) wherein

- n is 3 or 4;
- m is 1;
- R<sub>1</sub> and R<sub>2</sub> are hydrogen;
- R<sub>3</sub> is chlorine or bromine;

B is selected from



wherein  $\text{R}_4$ ,  $\text{R}_5$ ,  $\text{R}_6$ ,  $\text{R}_7$ ,  $\text{R}_8$ ,  $\text{R}_{10}$ ,  $\text{R}_{11}$  and  $\text{R}_{12}$  are, independently from each other, hydrogen or methyl;  $\text{R}_9$  is hydrogen.

5 Another class of preferred compounds of formula (I) are those wherein the acrylamido moiety is directly linked to a pyrazole or imidazole ring.

10 Examples of specific compounds according to the present invention, especially in the form of salts, preferably with hydrochloric acid, are the following:

- 15 (1) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;
- (2) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- 20 (3) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- (4) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine;
- 25 (5) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine;
- 30



- (6) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-trimethylamidine;
- 5 (7) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamide;
- 10 (8) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamide;
- 15 (9) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;
- 20 (10) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;
- (11) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propyl-N,N-dimethylamine;
- 25 (12) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;
- 30 (13) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;
- 35 (14) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

- (15) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-0-methylamidoxime;
- 5 (16) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionitrile;
- 10 (17) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionitrile;
- 15 (18) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propioncyanamidine;
- 20 (19) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamidine;
- (20) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N'-dimethylamidine;
- 25 (21) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N,N'-trimethylamidine;
- 30 (22) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionamide;
- 35 (23) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamide;

- (24) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;
- 5 (25) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;
- (26) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propyl-N,N-dimethylamine;
- 10 (27) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionamidoxime;
- 15 (28) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionamidoxime;
- 20 (29) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-O-methylamidoxime;
- 25 (30) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-O-methylamidoxime;
- (31) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionitrile;
- 30 (32) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamidine;
- 35

- (33) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamidine;
- 5 (34) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N'-dimethylamidine;
- 10 (35) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N,N'-trimethylamidine;
- 15 (36) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamide;
- 20 (37) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;
- (38) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;
- 25 (39) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionamidoxime;
- 30 (40) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionitrile;
- 35 (41) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propioncyanamidine;

- (42) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamide;
- 5 (43) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N-dimethylamine;
- 10 (44) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-O-methylamidoxime;
- 15 (45) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionitrile;
- 20 (46) 3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)propion-N-methylamidine;
- 25 (47) 3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)propion-N,N'-dimethylamidine;
- 30 (48) 2-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)ethylguanidine;
- 35 (49) 3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)propionamidoxime;
- (50) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)propion-N-methylamidine;

- (51) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)propionamide;
- 5 (52) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)ethylguanidine;
- 10 (53) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)propionamidoxime;
- 15 (54) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N-methylamidine;
- 20 (55) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N'-dimethylamidine;
- 25 (56) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;
- 30 (57) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionamidoxime;
- 35 (58) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionitrile;
- (59) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;
- (60) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -

bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;

5 (61) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;

10 (62) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine;

15 (63) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-trimethylamidine;

(64) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamide;

20 (65) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

(66) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

25 (67) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

30 (68) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(69) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

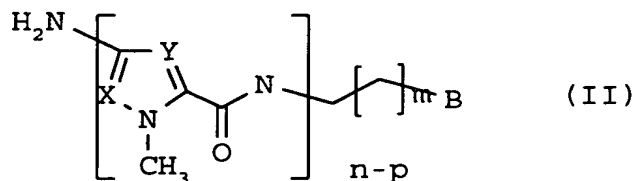
35 (70) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncicianamidine;

- (71) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N-  
methyramidine;
- 5 (72) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N'-  
dimethyramidine;
- 10 (73) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-  
trimethyramidine;
- (74) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propionamide;
- 15 (75) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N-  
methyramidine;
- 20 (76) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)ethylguanidine;
- (77) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N-
- 25 dimethylamine;
- (78) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propionamidoxime;
- 30 (79) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-O-  
methyramidoxime;
- (80) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propionitrile.
- 35



The compounds of the present invention can be prepared according to one of the following processes, which comprise:

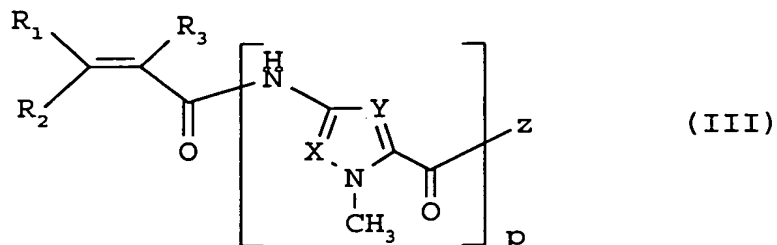
- 5 (a) reacting a compound of formula:



wherein n, m, X, Y and B are as defined above;

p is 0 or 1;

with a compound of formula:



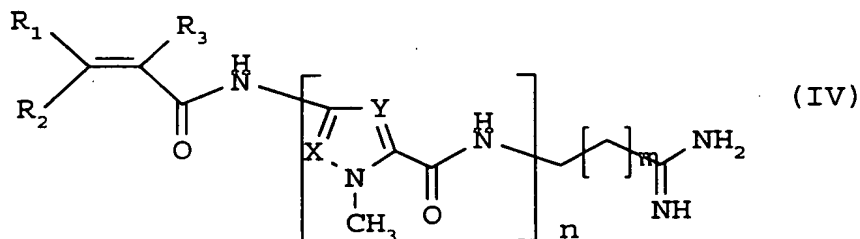
10

wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, X, Y and p are as defined above;

Z is hydroxy or a leaving group;

or:

- (b) when B is equal to -C≡N, reacting a compound of  
15 formula:



wherein n, m, R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, X and Y are as defined above;

with succinic anhydride; and

- (c) if desired, converting a compound of formula (I) into  
20 a pharmaceutically acceptable salt thereof.

In the compounds of formula (III), Z is hydroxy or a suitable leaving group selected, for instance, among chloro, 2,4,5-trichlorophenoxy, 2,4-dinitro-phenoxy,

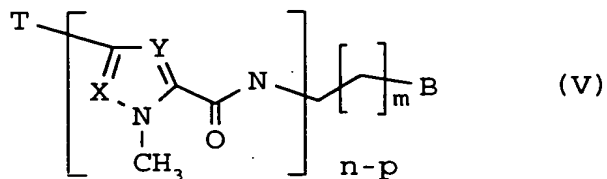
succinimido-N-oxy, imidazolyl group, and the like.

The reaction of process (a) as above between a compound of formula (II) and a compound of formula (III) can be carried out according to known methods, for instance those described in the aforementioned EP-A-246,868 and WO 96/05196.

It is clear to the man skilled in the art that when preparing the compounds of formula (I) according to the process object of the present invention, optional amino groups, i.e.  $R_{10}$  and/or  $R_{11}$  of the compound of formula (II) equal to hydrogen, need to be properly protected according to conventional techniques, so as to avoid unwanted side reactions.

Likewise, the conversion of the said protected amino group into the free amine may be carried out according to known procedures. See, for a general reference, J. Org. Chem. 43, 2285, (1978); J. Org. Chem. 44, 811 (1979); J. Am. Chem. Soc. 78, 1359 (1956); Ber. 65, 1192 (1932); and J. Am Chem. Soc. 80, 1154, (1958).

The compounds of formula (II) may be prepared by converting the compounds of formula (V)

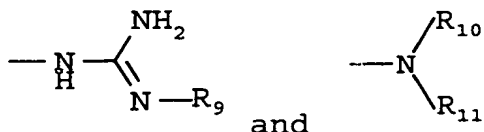


wherein T is a nitro group or an amino group properly protected with a group such as, for instance, t-butyloxycarbonyl, triphenylmethyl or, preferably, carbobenzyloxy or formyl; X, Y, B, n, m and p are as defined above; into the desired amino derivative of formula (II).

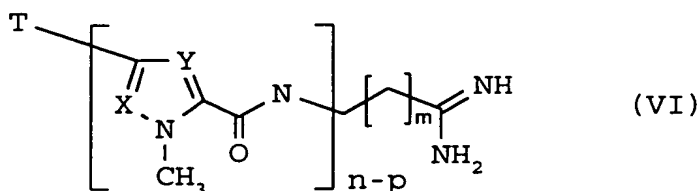
The conversion of the nitro group into amino group may be carried out according to known procedures such as, for instance, hydrogenation under hydrogen pressure in the presence of suitable catalysts, e.g., palladium on charcoal, into a suitable solvent such as dioxane, methanol, ethanol

and mixtures thereof, at room temperature.

The compounds of formula (V) wherein B is other than

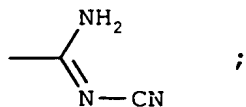


- 5 can be obtained, in their turn, from the compounds of formula:

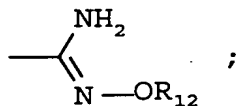


wherein T, X, Y, n, p and m are as defined above;  
by using:

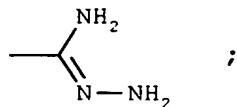
- 10 (i)  $\text{H}_2\text{N}-\text{CN}$ , so obtaining a compound of formula (V) having B equal to:



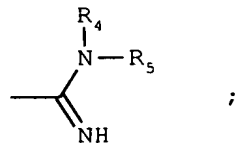
- (ii)  $\text{H}_2\text{N}-\text{OR}_{12}$  wherein  $\text{R}_{12}$  has the above reported meanings,  
so obtaining a compound of formula (V) having B  
15 equal to:



- (iii)  $\text{H}_2\text{N}-\text{NH}_2$ , so obtaining a compound of formula (V)  
having B equal to:

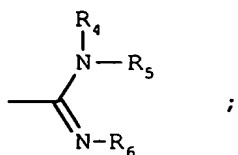


- 20 (iv)  $\text{HNR}_4\text{R}_5$ , so obtaining a compound of formula (V) having B equal to:



and then optionally with  $\text{H}_2\text{NR}_6$ , so obtaining a

compound of formula (V) having B equal to:

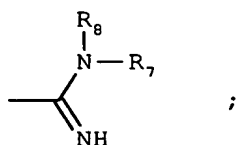


wherein  $R_4$ ,  $R_5$ , and  $R_6$  are as defined above;

(v) succinic anhydride, so obtaining a compound of formula (V) having B equal to  $-C\equiv N$ ;

(vi) water in an alkaline medium, so obtaining a compound of formula (V) having B equal to  $-CO-NR_7R_8$  wherein  $R_7$  and  $R_8$  are both hydrogen;

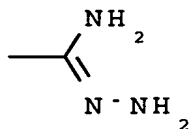
(vii)  $HNR_7R_8$ , so obtaining a compound of formula (V) having B equal to:



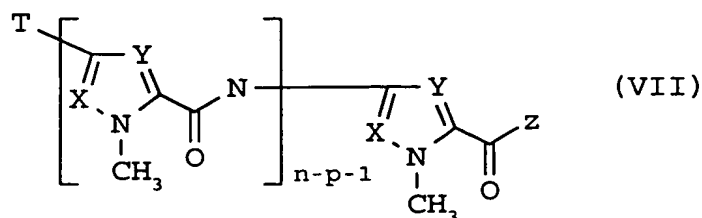
and then with water in an alkaline medium, so obtaining a compound of formula (V) having B equal to  $-CO-NR_7R_8$ , wherein  $R_7$  and  $R_8$  are as defined above.

The reaction between a compound of formula (VI) and one of the reactants as set forth in points (i)-(vii) as above can be carried out according to known methods, for instance those reported in WO97/43258; Chem. Revs. 1961; 155; J. Med. Chem. 1984, 27, 849-857; Chem. Revs. 1970, 151; and "The Chemistry of Amidines and Imidates", edited by S. Patai, John Wiley & Sons, N.Y. (1975).

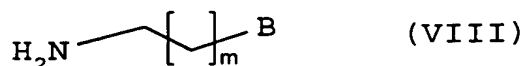
Alternatively, the compounds of formula (V) wherein B is other than



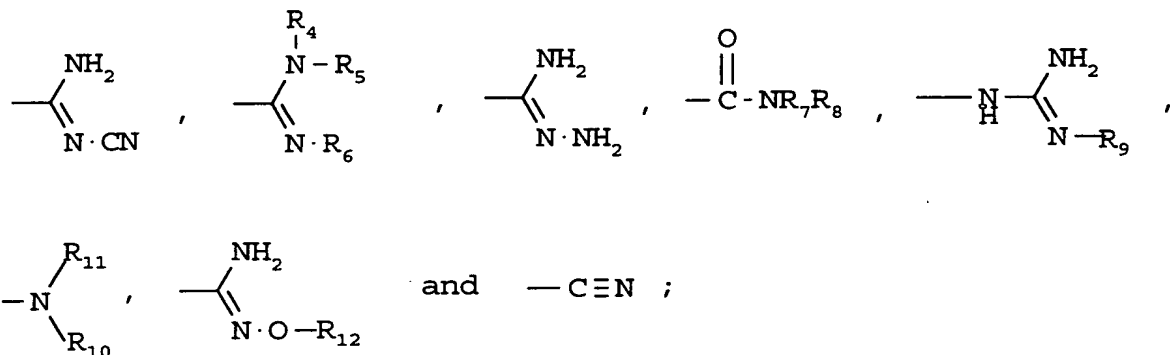
can be prepared from a compound of formula:



wherein n, p, X, Y, T and Z are as defined above, by reaction with a compound of formula:

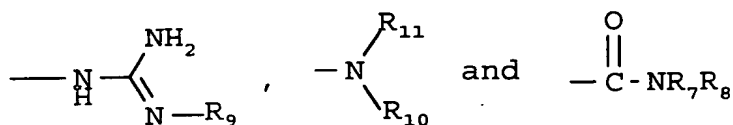


5 wherein m is as defined above and B is selected from:



wherein R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, R<sub>9</sub>, R<sub>10</sub>, R<sub>11</sub> and R<sub>12</sub> are as defined above.

10 Finally, the compounds of formula (V) wherein B is other than



15 can be prepared through the so-called Pinner reaction, by reacting a compound of formula (V) wherein B is equal to CN with a suitable amino compound as set forth above under points (i), (ii), (iii) or (iv).

Also the compounds of formula (III) are known or easily prepared according to conventional methods.

20 See, for a general reference, WO96/05196; J.C.S. 1947-1032 and JACS 62, 3495 (1940).

The reaction of process (b) is carried out according to the

method reported in WO 97/43258.

The compounds of formula (IV), (VI), (VII) and (VIII) are known compounds, or may be obtained by known methods (see, for a general reference, Tetrahedron, 34, 2389-2391, 1978; J. Org. Chem., 46, 3492-3497, 1981; J. Org. Chem., 52, 3493-3501, 1987; WO96/05196 and WO97/43258.

The optional conversion of a compound of formula (I) into a pharmaceutically acceptable salt, as well as the preparation of a free compound starting from a salt, may be carried out by known standard methods.

Well known procedures such as, e.g., fractional crystallization or chromatography, may also be followed for separating a mixture of isomers of formula (I) into the single isomers.

The compounds of formula (I) may be purified by conventional techniques such as, e.g., silica gel or alumina column chromatography, and/or by recrystallization from an organic solvent such as, e.g., a lower aliphatic alcohol, e.g. methyl, ethyl or isopropyl alcohol, or dimethylformamide.

The compounds of the invention show cytotoxic properties towards tumor cells so that they can be useful as antineoplastic agents, e.g. to inhibit the growth of various tumors such as, for instance, carcinomas, e.g. mammary carcinoma, lung carcinoma, bladder carcinoma, colon carcinoma, ovary and endometrial tumors. Other neoplasias in which the compounds of the invention could find application are, for instance, sarcomas, e.g. soft tissue and bone sarcomas, and the hematological malignancies such as, e.g., leukemias.

The antitumor activity of the compounds of formula (I) was evaluated in vitro by cytotoxicity studies carried out on murine L1210 leukemia cell. Cells were derived from in vivo tumors and established in cell culture. Cells were used until the tenth passage. Cytotoxicity was determined by

counting surviving cells after 4 hours treatment and 48 hours growth in drug-free medium.

The percentage of cell growth in the treated cultures was compared with that of controls. Doses inhibiting 50% of the cellular growth in respect to controls, expressed as ID<sub>50</sub> values, were calculated on dose-response curves.

The compounds of the invention can be administered by the usual routes, for example, parenterally, e.g. by intravenous injection or infusion, intramuscularly, subcutaneously, topically or orally.

The dosage depends on the age, weight and conditions of the patient and on the administration route.

For example, a suitable dosage for administration to adult humans may range from about 0.05 to about 100 mg pro dose 1-4 times a day.

The pharmaceutical compositions of the invention contain a compound of formula (I) as the active substance, in association with one or more pharmaceutically acceptable excipients.

The pharmaceutical compositions of the invention are usually prepared following conventional methods and are administered in a pharmaceutically suitable form.

For instance, solutions for intravenous injection or infusion may contain sterile water as a carrier or, preferably, they may be in the form of sterile aqueous isotonic saline solutions.

Suspensions or solutions for intramuscular injections may contain, together with the active compound, a pharmaceutically acceptable carrier, e.g. sterile water, olive oil, ethyl oleate, glycols, e.g. propylene glycol and, if desired, a suitable amount of lidocaine hydrochloride.

In the form for topical application, e.g. creams, lotions or pastes for use in dermatological treatment, the active ingredient may be mixed with conventional oleaginous or emulsifying excipients.

The solid oral forms, e.g. tablets and capsules, may contain, together with the active compound, diluents, e.g.

lactose, dextrose, saccharose, cellulose, corn starch and  
potato starch; lubricants, e.g. silica, talc, stearic acid,  
magnesium or calcium stearate, and/or polyethylene glycols;  
binding agents, e.g. starches, arabic gums, gelatin,  
5 methylcellulose, carboxymethyl-cellulose,  
polyvinylpyrrolidone; disaggregating agents, e.g. a starch,  
alginic acid, alginates, sodium starch glycolate;  
effervescing mixtures; dyestuffs; sweeteners; wetting  
agents, for instance, lecithin, polysorbates,  
10 laurylsulphates; and, in general, non-toxic and  
pharmacologically inactive substances used in pharmaceutical  
formulations. Said pharmaceutical preparations may be  
manufactured in a known manner, for example by means of  
mixing, granulating, tableting, sugar-coating, or film-  
15 coating processes.

Furthermore, according to the present invention, there is  
provided a method of treating tumors in a patient in need  
of it, comprising administering to the said patient a  
composition of the invention.

20 The following examples illustrate but do not limit the  
invention.

The abbreviations DMF and DMSO-d<sub>6</sub> stand for dimethylformamide  
and deuterio-dimethylsulfoxide, respectively.

25 Example 1

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- (α-bromo  
acrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)  
pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
30 propioncyanamidine

Step I: The intermediate 1-methyl-3- (α-bromoacrylamido) -  
pyrazole-5-carboxylic acid.

To a solution containing 0.620 g of ethyl 3-aminopyrazole-1-  
35 methyl-5-carboxylate and 0.3 g of 2-bromoacrylic acid in 10  
ml of dioxane, 0.412 g of N-N'dicyclohexylcarbodiimide were  
added and the mixture was stirred at room temperature



overnight. After filtration, the solvent was evaporated in vacuo, the solid residue was dissolved in 50 ml of ethyle acetate, treated with a saturated solution of sodium bicarbonate and then with 10% hydrochloric acid. The organic phase was dried over anhydrous sodium sulfate and the solvent evaporated in vacuo. The solid residue was purified by recrystallization from ethanol-water to yield 0.48 g of ethyl 1-methyl-3-( $\alpha$ -bromoacrylamido)-pyrazole-5-carboxylate. The derivative (0.48 g) was dissolved in 10 ml of dioxane and added of 1.6 ml of 2 N potassium hydroxide. The mixture was stirred overnight, acidified with 10% hydrochloric acid and the solvent was evaporated in vacuo yielding 0.40 g of intermediate.

PMR(DMSO- $d_6$ )  $\delta$ : 12.9 (b.s., 1H), 10.1 (s, 1H), 7.22 (s, 1H), 6.95 (d,  $J=3.7$ Hz, 1H), 6.43 (d,  $J=3.7$  Hz, 1H), 4.02 (s, 3H).

By analogous procedure the following compounds can be prepared:

1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxylic acid

PMR(DMSO- $d_6$ )  $\delta$ : 12.2 (b.s., 1H), 10.2 (s, 1H), 7.38 (d,  $J=1.8$  Hz, 1H), 6.85 (d,  $J=1.8$  Hz, 1H), 6.68 (d,  $J=3.7$  Hz, 1H), 6.2 (d,  $J=3.7$  Hz, 1H), 3.82 (s, 3H);

1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxylic acid

PMR (DMSO- $d_6$ )  $\delta$ : 11.08 (s, 1H), 7.58 (s, 1H), 6.82 (d,  $J=2.3$  Hz, 1H), 6.29 (d,  $J=2.3.8$  Hz, 1H), 3.81 (s, 3H);

1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxylic acid;

1-methyl-2-( $\alpha$ -chloroacrylamido)pyrrole-4-carboxylic acid

FAB-MS:  $m/z$  228(40,  $[M+H]^+$ ), 193, 139

PMR(DMSO- $d_6$ )  $\delta$ : 12.20 (b.s., 1H), 10.24 (s, 1H), 7.39 (d,  $J=2.0$  Hz, 1H), 6.88 (d,  $J=2.0$  Hz, 1H), 6.37 (d,  $J=2.2$  Hz, 1H), 5.99 (d,  $J=2.2$  Hz, 1H), 3.81 (s, 3H);

1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxylic acid.

**Step II:** The intermediate 1-methyl-3-( $\alpha$ -

bromoacrylamido)pyrazole 5-carboxyl chloride

The intermediate obtained from step I (1.2 g) was dissolved in 40 ml of benzene and added of 10 ml of  $SOCl_2$ . After

refluxing for 1 hour the solution was evaporated to dryness in vacuo to give 1.4 g of the intermediate.

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

- 1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxyl chloride;
- 1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxyl chloride;
- 1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxyl chloride;
- 1-methyl-4-( $\alpha$ -chloroacrylamido)pyrrole-2-carboxyl chloride;
- 1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxyl chloride.

**Step III:** The intermediate 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidinium hydrochloride

To a solution of 324 mg of cyanamide in 20 ml of DMF 186 mg of sodium hydride were added. The mixture was stirred at room temperature for 30 min. and then added to a solution of 1 g of distamycin A in 10 ml DMF. The solution was stirred at room temperature for two hours and acetic acid was then added up to pH=7. The solvent was removed at reduced pressure and the crude residue purified by flash chromatography (methylene chloride/methanol:9/1) to give 900 mg of 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-formamidopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido] propioncyanamidinium which was dissolved in 50 ml of methanol and added with 5 ml of 2 N hydrochloric acid.

The reaction mixture was stirred at room temperature for two days, the solvent was evaporated in vacuo and the solid residue suspended in 200 ml of ethyl acetate, yielding after filtration 600 mg of the intermediate.

FAB-MS: m/z 479(65, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>)  $\delta$ : 10.11 (s, 3H), 9.97 (s, 1H), 9.80-9.60 (b.s., 2H), 8.50-8.00 (b.s., 3H), 7.40 (t, J=5.8 Hz, 1H), 7.25 (d, J=1.7 Hz, 1H), 7.19 (d, J=1.7 Hz, 1H), 7.08 (d,

J=1.7 Hz, 1H), 7.06 (d, J=1.7 Hz, 1H), 6.94 (d, J=1.7 Hz, 1H), 6.88 (d, J=1.7 Hz, 1H), 3.81 (s, 3H), 3.79 (s, 3H), 3.75 (s, 3H), 3.41 (m, 2H), 2.70 (m, 2H).

5 By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidinium hydrochloride;

10 3-[1-methyl-4-[1-methyl-4-[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidinium hydrochloride.

Step IV: The title compound

15 To a solution of 205 mg of the intermediate obtained from step III, 100 mg of NaHCO<sub>3</sub> in 40 ml of water and 20 ml of dioxane, a solution of 175 mg of the intermediate obtained from step II in 40 ml of dioxane was added. The solution was stirred for 2 hours at room temperature then the  
20 solvent was evaporated in vacuo and the crude residue was purified by flash chromatography (methylene chloride/methanol:10/1) to give 145 mg of the title compound as a white solid.

FAB-MS: m/z 734 (90, [M+H]<sup>+</sup>)

25 PMR (DMSO-d<sub>6</sub>) δ: 11.00 (s, 1H), 10.47 (s, 1H), 9.99 (s, 1H), 9.90 (s, 1H), 8.80-8.00 (b.s., 3H), 7.35 (s, 1H), 7.30 (d, J=1.7 Hz, 1H), 7.24 (d, J=1.7 Hz, 1H), 7.19 (d, J=1.7 Hz, 1H), 7.08 (d, J=1.7 Hz, 1H), 7.03 (d, J=1.7 Hz, 1H), 6.87 (d, J=1.7 Hz, 1H), 6.79 (d, J=3.1 Hz, 1H), 6.31 (d, J=3.1  
30 Hz, 1H), 4.04 (s, 3H), 3.86 (s, 3H), 3.83 (s, 3H), 3.79 (s, 3H), 3.40 (b.s., 2H), 2.80-2.30 (b.s., 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

35 (18) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-(α-bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidinium

FAB-MS: m/z 734 (95, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ: 10.52 (s, 1H), 10.12 (s, 1H), 9.94 (s, 1H), 9.90 (s, 1H), 8.80-8.00 (b.s., 3H), 7.52 (s, 1H), 7.26 (d, J=1.7 Hz, 1H), 7.23 (d, J=1.7 Hz, 1H), 7.18 (d, J=1.7 Hz, 1H), 7.14 (d, J=1.7 Hz, 1H), 7.04 (d, J=1.7 Hz, 1H), 6.87 (d, J=1.7 Hz, 1H), 6.80 (d, J=3.0 Hz, 1H), 6.30 (d, J=3.0 Hz, 1H), 3.97 (s, 3H), 3.84 (s, 3H), 3.83 (s, 3H), 3.79 (s, 3H), 3.60-3.20 (b.s., 2H), 2.80-2.30 (b.s., 2H);

(41) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-(α-bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;

(59) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(α-bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;

(70) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(α-bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine.

## 20 Example 2

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-(α-bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine hydrochloride

25

Step I: The intermediate 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidine dihydrochloride

30 A solution of 2 g of distamycin A in 50 ml DMF was treated with 0.38 ml of methylamine hydrochloride 80%. After 8 hours additional 0.25 equivalents of methylamine hydrochloride 80% were added. The solution was evaporated to dryness and the crude residue was purified by flash  
35 chromatography (methylene chloride/methanol:8/2) to give 1.5 g of 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-

formamidopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidine hydrochloride which was dissolved in 40 ml of methanol and added with 5 ml of 2 N hydrochloric acid.

- 5 The reaction was stirred at room temperature for two days, the solvent evaporated in vacuo and the solid residue suspended in 200 ml of ethyl acetate, yielding after filtration 1.4 g of the intermediate.

FAB-MS: m/z 468 (40, [M+H]<sup>+</sup>)

- 10 PMR (DMSO-d<sub>6</sub>) δ: 10.20 (s, 3H), 10.18 (s, 1H), 9.98 (s, 1H), 9.65 (m, 1H), 9.20 (s, 1H), 8.63 (s, 1H), 8.25 (t, J=5.8 Hz, 1H), 7.25 (d, J=1.7 Hz, 1H), 7.19 (d, J=1.7 Hz, 1H), 7.11 (d, J=1.7 Hz, 1H), 7.08 (d, J=1.7 Hz, 1H), 7.05 (d, J=1.7 Hz, 1H), 6.91 (d, J=1.7 Hz, 1H), 3.90 (s, 3H), 3.85 (s, 3H), 3.79 (s, 3H), 3.60-3.40 (m, 2H), 2.80 (d, J=6 Hz, 3H), 2.61 (m, 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

- 20 3-[1-methyl-4-[1-methyl-4-[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidine dihydrochloride;  
3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]  
25 propion-N-methylamidine dihydrochloride;  
3-[1-methyl-5-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrazole-3-carboxamido]propion-N-methylamidine dihydrochloride;  
3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]  
30 propion-N-methylamidine dihydrochloride.

**Step II:** The title compound

- To a solution containing 0.20 g of the intermediate obtained from step I in 10 ml of dry DMF, 0.15 g of intermediate obtained from example I step I, 0.153 g of 1-ethyl-3-(3'-dimethylaminopropyl)carbodiimide hydrochloride and 0.09 ml of N,N'-diisopropylethylamine were added. The mixture was
- 35

stirred overnight at room temperature and brought to pH 4-5 with 10% hydrochloric acid.

After evaporation in vacuo of the solvent a solid residue was obtained which was purified by flash chromatography (methylene chloride/methanol:8/2) yielding 0.13 g of the title compound.

FAB-MS: m/z 723(95, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ: 11.02 (s, 1H), 10.48 (s, 1H), 10.00 (s, 1H), 9.92 (s, 1H), 9.52 (q, J=5.0 Hz, 1H), 9.12 (b.s., 1H), 8.56 (b.s., 1H), 8.22 (t, J=5.0 Hz, 1H), 7.35 (s, 1H), 7.31 (d, J=1.7 Hz, 1H), 7.24 (d, J=1.7 Hz, 1H), 7.18 (d, J=1.7 Hz, 1H), 7.09 (d, J=1.7 Hz, 1H), 7.06 (d, J=1.7 Hz, 1H), 6.93 (d, J=1.7 Hz, 1H), 6.80 (d, J=3.2 Hz, 1H), 6.31 (d, J=3.2 Hz, 1H), 4.00 (s, 3H), 3.86 (s, 3H), 3.83 (s, 3H), 3.79 (s, 3H), 3.49 (m, 2H), 2.78 (d, J=5.0 Hz, 3H), 2.59 (m, 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

(3) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-(α-chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;

(19) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-(α-bromoacrylamido)imidazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine

FAB-MS: m/z 723(100, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ: 10.54 (s, 1H), 10.11 (s, 1H), 9.97 (s, 1H), 9.91 (s, 1H), 9.50 (b.s., 1H), 9.10 (b.s., 1H), 8.55 (b.s., 1H), 8.21 (t, J=5.6Hz, 1H), 7.52 (s, 1H), 7.26 (d, J=1.7 Hz, 1H), 7.23 (d, J=1.7 Hz, 1H), 7.17 (d, J=1.7 Hz, 1H), 7.16 (d, J=1.7 Hz, 1H), 7.06 (d, J=1.7 Hz, 1H), 6.92 (d, J=1.7 Hz, 1H), 6.80 (d, J=3.0 Hz, 1H), 6.30 (d, J=3.0 Hz, 1H), 3.97 (s, 3H), 3.84 (s, 3H), 3.83 (s, 3H), 3.79 (s, 3H), 3.49 (m, 2H), 2.78 (d, J=4.7Hz, 3H), 2.58 (t, J=6.0Hz, 2H);

- (32) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- 5 (33) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- (46) 3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)propion-N-methylamidine;
- 10 (50) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)propion-N-methylamidine;
- 15 (54) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- 20 (60) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- (61) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;
- 25 (71) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine.
- 30

**Example 3**

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine hydrochloride

35

Step I: The intermediate 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido] pyrrole-2-carboxamido]propion-N,N'-dimethylamidine dihydrochloride

A solution of 1.5 g of distamycin A in 40 ml DMF was heated to 80°C and treated with 4 ml of methylamine hydrochloride 80%. After 4 hours additional 5 equivalents (4 ml) of methylamine hydrochloride 80% were added. The solution was evaporated to dryness and the crude residue was purified by flash chromatography (methylene chloride/methanol:8/2) to yield 1.2 g of 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-formamidopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N'-dimethylamidine hydrochloride which was dissolved in 40 ml of methanol and added with 5 ml of 2 N hydrochloric acid solution.

The reaction was stirred at room temperature for two days, the solvent evaporated in vacuo and the solid residue suspended in 200 ml of ethyl acetate, yielding after filtration 1.4 g of the intermediate.

FAB-MS: m/z 482(45, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ: 10.21 (s, 3H), 10.18 (s, 1H), 9.98 (s, 1H), 9.61 (m, 1H), 8.85 (s, 1H), 8.39 (t, J=5.8 Hz, 1H), 8.00-7.70 (b.s., 1H), 7.28 (d, J=1.7 Hz, 1H), 7.22 (d, J=1.7 Hz, 1H), 7.12 (d, J=1.7 Hz, 1H), 7.08 (d, J=1.7 Hz, 1H), 7.03 (d, J=1.7 Hz, 1H), 6.92 (d, J=1.7 Hz, 1H), 3.92 (s, 3H), 3.89 (s, 3H), 3.86 (s, 3H), 3.60-3.40 (m, 2H), 3.02 (d, J=6 Hz, 3H), 2.80 (d, J=6 Hz, 3H), 2.72 (m, 2H).

By analogous procedure and by using the opportune starting material the following compounds can be obtained:

3-[1-methyl-4-[1-methyl-4-[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N'-dimethylamidine dihydrochloride;

3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N'-dimethylamidine dihydrochloride;



3-[1-methyl-3-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrazole-5-carboxamido]propion-N,N'-dimethylamidine dihydrochloride;

5 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propion-N,N'-dimethylamidine dihydrochloride;

3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N,N'-trimethylamidine dihydrochloride

10 FAB-MS: m/z 482, (45, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ : 10.21 (s, 3H), 10.18 (s, 1H), 9.61 (m, 1H), 8.85 (s, 1H), 8.39 (t, J=5.8 Hz, 1H), 8.00-7.70 (b.s., 1H), 7.28 (d, J=1.7 Hz, 1H), 7.22 (d, J=1.7 Hz, 1H), 7.12 (d, J=1.7 Hz, 1H), 7.08 (d, J=1.7 Hz, 1H), 7.03 (d, J=1.7 Hz, 1H), 6.92 (d, J=1.7 Hz, 1H), 3.92 (s, 3H), 3.89 (s, 3H), 3.86 (s, 3H), 3.60-3.40 (m, 2H), 3.02 (d, J=6 Hz, 3H), 2.80 (d, J=6 Hz, 3H), 2.72 (m, 2H);

3-[1-methyl-4-[1-methyl-4-[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N,N'-trimethylamidine dihydrochloride;

20 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N,N'-trimethylamidine dihydrochloride.

25 Step II: The title compound

To a solution of 100 mg of the intermediate obtained from step I, 50 mg of NaHCO<sub>3</sub> in 10 ml of water, was added to a solution of 85 mg of the intermediate obtained from step II example 1 in 15 ml of benzene. The slurry was vigorously stirred for 1 hour at room temperature then the solvent was evaporated in vacuo and the crude residue was purified by flash chromatography (methylene chloride/methanol:8/2) to give 80 mg of the title compound as a white solid.

30 FAB-MS: m/z 737(95, [M+H]<sup>+</sup>)

35 PMR (DMSO-d<sub>6</sub>) δ: 11.02 (s, 1H), 10.47 (s, 1H), 9.99 (s, 1H), 9.92 (s, 1H), 9.40 (q, J=4.7 Hz, 1H), 8.65 (q, J=4.7 Hz, 1H), 8.27 (t, J=5.0 Hz, 1H), 7.34 (s, 1H), 7.30 (d, J=1.7 Hz, 1H), 7.23 (d, J=1.7 Hz, 1H), 7.18 (d, J=1.7 Hz, 1H),

7.08 (d, J=1.7 Hz, 1H), 7.06 (d, J=1.7 Hz, 1H), 6.93 (d, J=1.7 Hz, 1H), 6.79 (d, J=3.0 Hz, 1H), 6.32 (d, J=3.0 Hz, 1H), 4.04 (s, 3H), 3.86 (s, 3H), 3.83 (s, 3H), 3.79 (s, 3H), 3.45 (m, 2H), 3.00 (d, J=4.7 Hz, 3H), 2.77 (d, J=4.7 Hz, 3H), 2.70 (t, J=6.6 Hz, 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

(20) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine

FAB-MS: m/z 737(90, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>)  $\delta$ : 11.54 (s, 1H), 10.12 (s, 1H), 9.96 (s, 1H), 9.92 (s, 1H), 9.43 (q, J=5.0 Hz, 1H), 8.68 (q, J=4.7 Hz, 1H), 8.28 (t, J=4.9 Hz, 1H), 7.52 (s, 1H), 7.26 (d, J=1.7 Hz, 1H), 7.23 (d, J=1.7 Hz, 1H), 7.18 (d, J=1.7 Hz, 1H), 7.15 (d, J=1.7 Hz, 1H), 7.06 (d, J=1.7 Hz, 1H), 6.92 (d, J=1.7 Hz, 1H), 6.80 (d, J=3.0 Hz, 1H), 6.30 (d, J=3.0 Hz, 1H), 3.97 (s, 3H), 3.84 (s, 3H), 3.83 (s, 3H), 3.79 (s, 3H), 3.40 (m, 2H), 3.00 (d, J=4.7 Hz, 3H), 2.77 (d, J=5.0 Hz, 3H), 2.71 (t, J=6.8 Hz, 2H);

(5) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine;

(34) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine;

(47) 3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)propion-N,N'-dimethylamidine;

(55) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-

carboxamido) propion-N,N'-dimethylamidine;

(62) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N'-  
5 dimethylamidine;

(72) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N'-  
dimethylamidine;

10 (6) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)propion-N,N,N'-trimethylamidine;

(21) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
15 bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)propion-N,N,N'-trimethylamidine;

(35) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -  
20 bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)propion-N,N,N'-trimethylamidine;

(63) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-  
25 trimethylamidine;

(73) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-  
trimethylamidine.

30

#### Example 4

2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromo  
acrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)  
pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine  
35 hydrochloride

**Step I:** The intermediate 2-aminoethylguanidine  
dihydrochloride

A solution of commercial N-BOC-ethylendiamine (1 g) in dry  
5 ethanol (100 ml) and 2-methyl-2-thiopseudourea hydroiodide  
(1.5 g) was refluxed for 8 hours. The solvent was removed  
at reduced pressure and the crude residue purified by flash  
chromatography (methylene chloride/methanol:9/1) to yield  
1.5 g of N-BOC-2-aminoethylguanidine hydroiodide as a  
10 yellow oil which was dissolved in methanolic hydrochloric  
acid solution 5N (20 ml) and stirred at room temperature  
for 3 hours. The white precipitate was collected, washed  
with dry ethanol, affording 700 mg of the intermediate.

FAB-MS: m/z 103 (20, [M+H]<sup>+</sup>)

15 PMR (DMSO-d<sub>6</sub>) δ: 8.38 (b.s., 3H), 7.97 (t, J= 6 Hz, 1H),  
7.51 (b.s., 4H), 3.45 (m, 2H), 2.92 (m, 2H).

**Step II:** The intermediate 2-[1-methyl-4[1-methyl-4[1-  
methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-  
20 carboxamido] pyrrole-2-carboxamido]ethylguanidine  
dihydrochloride

A solution of 1-methyl-4-[1-methyl-4-[1-methyl-4-  
nitropyrrole -2-carboxamido]pyrrole-2-carboxamido]pyrrole-  
2-carboxylic acid (590 mg) (prepared as reported in  
25 Tetrahedron 34, 2389-2391, 1978) in 20 ml of DMF, 2-  
aminoethylguanidine dihydrochloride (500 mg), 1-  
hydroxybenzotriazole hydrate (350 mg),  
dicyclohexylcarbodiimide (880 mg), and sodium bicarbonate  
(385 mg) was stirred at 70°C for 4 hours. The solution  
30 obtained after filtration was evaporated in vacuo and the  
residue purified by flash chromatography (methylene  
chloride/methanol:8/2) to yield 800 mg of 2-[1-methyl-4-[1-  
methyl-4-[1-methyl-4-nitropyrrole-2-carboxamido]pyrrole-2-  
carboxamido]pyrrole-2-carboxamido]ethylguanidine  
35 hydrochloride, which was dissolved in methanol (100 ml),  
treated with 1N hydrochloric acid solution (2 ml) and  
reduced over Pd catalyst (10% on charcoal) under hydrogen

atmosphere (50 psi) into a Parr apparatus. The solution obtained after filtration of the catalyst was evaporated in vacuo and the solid residue washed with dry ethanol to yield 750 mg of the intermediate as a brown powder.

5 FAB-MS: m/z 469(15, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ: 10.38-10.11 (b.s., 4H), 9.98 (s, 1H), 8.28 (b.s., 1H), 8.19 (d, J= 1.7 Hz, 1H), 7.73, (b.s., 1H), 7.63 (d, J= 1.7 Hz, 1H), 7.60-7.00 (b.s., 4H), 7.28 (d, J= 1.7 Hz, 1H), 7.20 (d, J= 1.7 Hz, 1H), 7.1 (d, J= 1.7 Hz, 1H), 6.92 (d, J= 1.7 Hz, 1H), 3.93 (s, 3H), 3.90 (s, 3H), 3.82 (s, 3H), 3.28 (m, 4H).

By analogous procedure and by using the suitable starting materials the following compounds can be obtained:

- 15 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidinium hydrochloride;
- 20 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidinium hydrochloride;
- 25 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidinium dihydrochloride;
- 30 3-[1-methyl-4-[1-methyl-4-[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidinium dihydrochloride;
- 35 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N,N'-dimethylamidinium dihydrochloride;
- 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propionamide hydrochloride;
- 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propionamide hydrochloride;
- 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-

carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]  
propion-N,N-dimethylamine dihydrochloride;  
3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-  
carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]  
5 propion-N,N-dimethylamine dihydrochloride;  
3-[1-methyl-4[1-methyl-4[1-methyl-4-aminopyrrole-2-  
carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]  
propionitrile hydrochloride;  
2-[1-methyl-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-  
10 2-carboxamido]ethylguanidine dihydrochloride;  
2-[1-methyl-[1-methyl-3-aminopyrazole-5-  
carboxamido]pyrrole-2-carboxamido]ethylguanidine  
dihydrochloride;  
2-[1-methyl-[1-methyl-4-aminoimidazole-2-  
15 carboxamido]pyrrole-2-carboxamido]ethylguanidine  
dihydrochloride;  
2-[1-methyl-3[1-methyl-4[1-methyl-4-aminopyrrole-2-  
carboxamido]pyrrole-2-carboxamido]pyrazole-5-carboxamido]  
ethylguanidine hydrochloride;  
20 2-[1-methyl-4[1-methyl-4[1-methyl-4-aminopyrrole-2-  
carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]  
ethylguanidine hydrochloride.

Step III: The title compound

25 A solution of 250 mg of 1-methyl-3-( $\alpha$ -bromoacrylamido)  
pyrrole-5-carboxyl chloride (prepared as reported in  
Example 1 step III) in 15 ml of benzene, was added to a  
solution of the intermediate obtained from step II (250 mg)  
and 82 mg of NaHCO<sub>3</sub> in 5 ml of H<sub>2</sub>O. The solution was  
30 vigorously stirred for 8 hours at room temperature, then  
evaporated in vacuo and the crude residue was purified by  
flash chromatography (methylene chloride/methanol:8/2) to  
yield 220 mg of the title compound as a yellow solid.

FAB-MS: m/z, 723(45, [M+H]<sup>+</sup>)

35 PMR (DMSO-d<sub>6</sub>)  $\delta$ : 10.30 (s, 1H), 9.95 (s, 1H), 9.92 (s, 1H),  
9.90 (s, 1H), 8.10 (t, J=5.9 Hz, 1H), 7.56 (t, J=5.9, 1H),  
7.34 (s, 1H) 7.2 (b.s., 4H), 7.23 (m, 3H), 7.19 (d, J=1.7  
Hz, 1H), 7.04 (d, J=1.7Hz, 1H), 6.98 (d, J=1.7 Hz, 1H),

6.68 (d, J=2.9 Hz, 1H), 6.21 (d, J=2.9 Hz, 1H), 3.85 (s, 3H), 3.84 (s, 3H), 3.83 (s, 3H), 3.80 (s, 3H), 3.30 (b.s., 4H).

5 By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

(10) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

(24) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

15 (25) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

(37) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

(38) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)ethylguanidine;

(48) 2-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)ethylguanidine;

(52) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)ethylguanidine;

35 (56) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-

carboxamido) ethylguanidine;

(65) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;

5 (66) 2-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;

(76) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) ethylguanidine;

10 (11) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propyl-N,N-dimethylamine;

15 (26) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propyl-N,N-dimethylamine;

(43) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N-dimethylamine;

20 (77) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propion-N,N-dimethylamine.

#### Example 5

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido) propionamidoxime

Step I: The intermediate 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido] propionamidoxime hydrochloride



1.2 g of 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-nitropyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido] propionitrile (prepared as reported in J. Med. Chem 22, 1296-1301, 1979) was suspended in dry ethanol and the solution saturated with dry hydrogen chloride. After 24 hours at room temperature, the solvent was evaporated under vacuo and the residue treated with two equivalents of solution of hydroxylamine in dry ethanol. After 24 hours at room temperature, the solvent was evaporated in vacuo and the residue purified by flash chromatography yielding 500 mg of 3-[1-methyl-4-[1-methyl-4-[1-methyl-4-nitropyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido] propionamidoxime which was dissolved in a mixture of methanol-dioxane-10% hydrochloric acid (4:1:1) and reduced over Pd catalyst (10% on charcoal) under hydrogen atmosphere (50 psi) into a Parr apparatus. The solution obtained after filtration of the catalyst was evaporated in vacuo, and the solid residue suspended in dry ethanol, and filtered to yield 500 mg of the intermediate. FAB-MS: m/z 480 (20, [M+H]<sup>+</sup>)  
PMR (DMSO-d<sub>6</sub>) δ : 10.18 (b.s., 6H), 9.98 (s, 1H), 8.32 (t, J=5.7 Hz, 1H), 7.25 (d, J=1.7 Hz, 1H), 7.20 (d, J=1.7 Hz, 1H), 7.16 (d, J=1.7 Hz, 1H), 7.12 (d, J=1.7 Hz, 1H), 7.10 (d, J=1.7 Hz, 1H), 6.93 (d, J=1.7 Hz, 1H), 3.89 (s, 3H), 3.86 (s, 3H), 3.82 (b.s., 7H), 3.50 (m, 2H), 2.72 (m, 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

30 3-[1-methyl-4-[1-methyl-4-[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido] propionamidoxime hydrochloride;  
3-[1-methyl-4-[1-methyl-4-[1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido] propionamidoxime hydrochloride;  
35 3-[1-methyl-3-[1-methyl-4-[1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrazole-5-carboxamido] propionamidoxime hydrochloride;

3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propionamidoxime hydrochloride;

3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidoxime hydrochloride;

3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propion-N-methylamidoxime hydrochloride;

10 3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidine dihydrochloride;

3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propion-N-methylamidine dihydrochloride;

15 3- [1-methyl-4- [1-methyl-4- [1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamidine dihydrochloride;

20 3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminopyrrole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidine hydrochloride;

3- [1-methyl-4- [1-methyl-4- [1-methyl-4-aminoimidazole-2-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propioncyanamidine hydrochloride.

25

Step II: The title compound

To a solution of 200 mg of the intermediate obtained from step I, 100 mg of NaHCO<sub>3</sub> in 40 ml of water and 20 ml of dioxane, a solution of 175 mg of the intermediate obtained from step II example I in 40 ml of dioxane was added. The solution was stirred for 2 hours at room temperature then the solvent was evaporated in vacuo and the crude residue was purified by flash chromatography (methylene chloride/methanol :9/1) to give 120 mg of the title compound as a white solid.

FAB-MS: m/z 724 (50, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ : 10.28 (s, 1H), 9.97 (s, 1H), 9.93 (s, 1H), 9.92 (s, 1H), 9.80 (b.s., 2H), 8.32 (m, 1H), 7.35 (s, 1H),

7.25 (d, J=1.7 Hz, 1H), 7.20 (d, J=1.7 Hz, 1H), 7.16 (d, J=1.7 Hz, 1H), 7.12 (d, J=1.7 Hz, 1H), 7.10 (d, J=1.7 Hz, 1H), 6.93 (d, J=1.7 Hz, 1H), 3.89 (s, 3H), 3.86 (s, 3H), 3.82 (b.s., 7H), 3.40 (m, 2H), 2.64 (m, 2H).

5

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

(13) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(27) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(28) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(39) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(49) 3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrazole-5-carboxamido)propionamidoxime;

(53) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)propionamidoxime;

(57) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(67) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-

carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(68) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

5 (78) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

(14) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-

10 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

(15) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-

15 carboxamido)propion-O-methylamidoxime;

(29) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

20 (30) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

(44) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

(79) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

30 (70) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;

35 (71) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-

carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;

Example 6

3-[1-methyl-4[1-methyl-4[1-methyl-4[1-methyl-3( $\alpha$ -bromo  
acrylamido)pyrazole-5-carboxamido]pyrrole-2-carboxamido]  
pyrrole-2-carboxamido]pyrrole-2-carboxamido]propionitrile

To a solution of 350 mg of 3-[1-methyl-4[1-methyl-4[1-methyl-4-[1-methyl-3( $\alpha$ -bromoacrylamido)pyrazole-5-

carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]

pyrrole-2-carboxamido]propionamidine hydrochloride

(prepared as reported in WO 90/05196) in 20 ml of DMF, were added 120 mg of succinic anhydride and 165 mg of  $K_2CO_3$ . The solution was heated at 60°C for 3 hours then the solvent evaporated under reduced pressure and the crude residue was purified by flash chromatography (methylene chloride/methanol:95/5) to yield 150 mg of the title compound as a pale yellow solid.

FAB-MS: m/z, 691(70,  $[M+H]^+$ )

PMR (DMSO- $d_6$ )  $\delta$ : 11.02 (s, 1H), 10.48 (s, 1H), 10.00 (s, 1H), 9.92 (s, 1H), 8.21 (m, 1H), 7.35 (s, 1H), 7.30 (d, J=1.8 Hz, 1H), 7.24 (d, J=1.8 Hz, 1H), 7.17 (d, J=1.8 Hz, 1H), 7.09 (d, J=1.8 Hz, 1H), 7.06 (d, J=1.8 Hz, 1H), 6.79 (d, J=3.4 Hz, 1H), 6.31 (d, J=3.4 Hz, 1H), 4.04 (s, 3H), 3.86 (s, 3H), 3.83 (s, 3H), 3.80 (s, 3H), 3.42 (m, 2H), 2.75 (m, 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

(17) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido]propionitrile;

(31) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido]propionitrile;

(40) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -

bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

5 (45) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

10 (58) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

(69) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

15 (80) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

**Example 7**

20 3-[1-methyl-4[1-methyl-4[1-methyl-3( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propionamide

25 **Step I:** The intermediate 3-[1-methyl-4[1-methyl-4[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propionamide hydrochloride

To a solution of 200 mg of 3-(1-methyl-4(1-methyl-4-(1-methyl-3-nitropyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidine  
30 hydrochloride (prepared as described in WO 96/05196) in 10 ml of acetonitrile and 10 ml of water, 2 ml of NaOH 1N were added. The solution was heated at 60°C for 4 hours then the solvent was evaporated in vacuo and the crude residue was purified by flash chromatography (methylene  
35 chloride/methanol:10/1) affording 175 mg of 3-(1-methyl-4(1-methyl-4-(1-methyl-3-nitropyrazole-5-carboxamido)pyrrole-2-

carboxamido)pyrrole-2-carboxamido)propionamide as a light yellow solid.

The nitro derivative (170 mg) was dissolved in a mixture of 20 ml of methanol-dioxane-10%hydrochloric acid (4:1:1) and reduced over Pd catalyst (10% on charcoal) under hydrogen pressure (50 psi) into a Parr apparatus. The solution obtained after filtration of the catalyst was evaporated to dryness giving a solid residue which was suspended in dry ethanol, and filtered to yield 150 mg of the intermediate as a white solid.

FAB-MS: 471 m/z, (60, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>) δ: 10.48 (s, 1H), 10.20 (s, 3H), 10.00 (s, 1H), 9.92 (s, 2H), 8.20 (m, 1H), 7.35 (s, 1H), 7.30 (d, J=1.8 Hz, 1H), 7.18 (s, 1H), 7.09 (d, J=1.8 Hz, 1H), 4.04 (s, 3H), 3.86 (s, 3H), 3.83 (s, 3H), 3.33 (m, 2H), 2.30 (m, 2H).

By analogous procedure and by using the opportune starting materials the following products can be obtained:

- 3-[1-methyl-4[1-methyl-4[1-methyl-4-aminoimidazole-4-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propionamide.hydrochloride;
- 3-[1-methyl-4[1-methyl-4[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propionamide.hydrochloride;
- 3-[1-methyl-4[1-methyl-4[1-methyl-4-aminopyrrole-4-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propionamide.hydrochloride;
- 3-[1-methyl-4[1-methyl-4[1-methyl-4-aminopyrrole-4-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamide.hydrochloride;
- 3-[1-methyl-4[1-methyl-4[1-methyl-3-aminopyrazole-5-carboxamido]pyrrole-2-carboxamido]pyrrole-2-carboxamido]propion-N-methylamide.hydrochloride;
- 3-[1-methyl-4[1-methyl-4[1-methyl-4-aminopyrrole-4-carboxamido]pyrrole-2-carboxamido]imidazole-2-carboxamido]propion-N-methylamide.hydrochloride.

**Step II:** The title compound

To a solution of 70 mg of  $\alpha$ -bromoacrylic acid in 8 ml of DMF, 50 mg of dicyclohexylcarbodiimide were added. The solution was stirred at room temperature for 20' then added  
5 of 110 mg of the intermediate obtained from step I and 18 mg of  $\text{NaHCO}_3$ . The mixture was stirred at room temperature for 8 hours, the solvent evaporated in vacuo and the crude residue purified by flash chromatography (methylene chloride/methanol:9/1) to give 70 mg of the title compound  
10 as a white solid.

FAB-MS:  $m/z$ , 587(75,  $[\text{M}+\text{H}]^+$ )

PMR ( $\text{DMSO}-d_6$ )  $\delta$ : 10.30 (s, 1H), 10.27 (s, 1H), 9.98 (s, 1H), 9.92 (s, 2H), 8.20 (m, 1H), 7.30 (s, 1H), 7.30 (d,  $J=1.8$  Hz, 1H), 7.20 (s, 1H), 7.09 (d,  $J=1.8$  Hz, 1H), 6.66 (d,  $J=3.0$  Hz, 1H), 6.20 (d,  $J=3.0$  Hz, 1H), 4.04 (s, 3H), 3.86  
15 (s, 3H), 3.83 (s, 3H), 3.33 (m, 2H), 2.30 (m, 2H).

By analogous procedure and by using the opportune starting materials the following compounds can be obtained:

20 (7) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamide

FAB-MS:  $m/z$  709(60,  $[\text{M}+\text{H}]^+$ )

25 PMR ( $\text{DMSO}-d_6$ )  $\delta$ : 11.02 (s, 1H), 10.48 (s, 1H), 10.00 (s, 1H), 9.92 (s, 1H), 9.50 (s, 2H), 8.22 (t,  $J=5.0$  Hz, 1H), 7.35 (s, 1H), 7.31 (d,  $J=1.7$  Hz, 1H), 7.24 (d,  $J=1.7$  Hz, 1H), 7.18 (d,  $J=1.7$  Hz, 1H), 7.09 (d,  $J=1.7$  Hz, 1H), 7.06 (d,  $J=1.7$  Hz, 1H), 6.93 (d,  $J=1.7$  Hz, 1H), 6.80 (d,  $J=3.2$  Hz, 1H), 6.31 (d,  $J=3.2$  Hz, 1H), 4.00 (s, 3H), 3.85 (s, 3H), 3.83 (s, 3H), 3.82 (s, 3H), 3.40 (m, 2H), 2.50 (m, 2H);

35 (8) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamide;

(22) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -



bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamide;

(23) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamide

FAB-MS: m/z 723 (80, [M+H]<sup>+</sup>)

PMR (DMSO-d<sub>6</sub>)  $\delta$ : 11.54 (s, 1H), 10.12 (s, 1H), 9.96 (s, 1H), 9.92 (s, 1H), 9.40 (m, 1H), 8.25 (m, 1H), 7.52 (s, 1H), 7.26 (d, J=1.7 Hz, 1H), 7.23 (d, J=1.7 Hz, 1H), 7.18 (d, J=1.7 Hz, 1H), 7.15 (d, J=1.7 Hz, 1H), 7.06 (d, J=1.7 Hz, 1H), 6.92 (d, J=1.7 Hz, 1H), 6.80 (d, J=3.0 Hz, 1H), 6.30 (d, J=3.0 Hz, 1H), 3.97 (s, 3H), 3.84 (s, 3H), 3.82 (s, 3H), 3.80 (s, 3H), 3.30 (m, 2H), 3.00 (s, 3H), 2.28 (m, 2H);

(36) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamide;

(42) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamide;

(51) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)pyrrole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)imidazole-2-carboxamido)propionamide;

(74) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamide;

(75) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamide;

(62) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-

dimethylamidine;

(63) 3-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-  
5 trimethylamidine;

(76) 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)ethylguanidine;

(77) 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
10 bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N-  
dimethylamine.

#### Example 8

15 Intramuscular injection 10 mg/ml

An injectable pharmaceutical composition was manufactured by  
dissolving 10 g of 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-  
(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-  
20 carboxamido)pyrrole-2-carboxamido) propion-N-methylamidine  
in water for injection (1000 ml) and sealing ampoules of 1-5  
ml.

#### Example 9

25 Capsules, each dosed at 0.200 g and containing 10 mg of the  
active substance were prepared as follows:

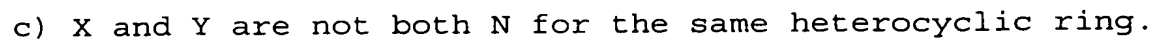
Composition for 500 capsules:

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromo  
acrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)  
30 pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-  
methylamidine hydrochloride 5 g  
Lactose 85 g  
Corn starch 5 g  
Magnesium stearate 5 g

35 This formulation can be encapsulated in two-piece hard  
gelatin capsules and dosed at 0.200 g for each capsule.

$$\begin{array}{c}
 R_1 \\
 \diagup \\
 C=C \\
 \diagdown \\
 R_2
 \end{array}
 \begin{array}{c}
 R_3 \\
 \diagup \\
 C \\
 \diagdown \\
 C=O
 \end{array}
 \begin{array}{c}
 H \\
 | \\
 N
 \end{array}
 \left[ \begin{array}{c}
 \diagup \\
 \diagdown
 \end{array} \right]_n
 \begin{array}{c}
 Y \\
 \diagup \\
 C \\
 \diagdown \\
 N-CH_3
 \end{array}
 \begin{array}{c}
 H \\
 | \\
 N
 \end{array}
 \begin{array}{c}
 \diagup \\
 \diagdown
 \end{array}
 \left[ \begin{array}{c}
 \diagup \\
 \diagdown
 \end{array} \right]_m
 B
 \quad (I)$$

B is selected from



2. A compound according to claim 1 wherein  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are, independently from each other, hydrogen, methyl, or ethyl.

5

3. A compound according to claim 1 or 2 wherein X and Y are as defined in claim 1;

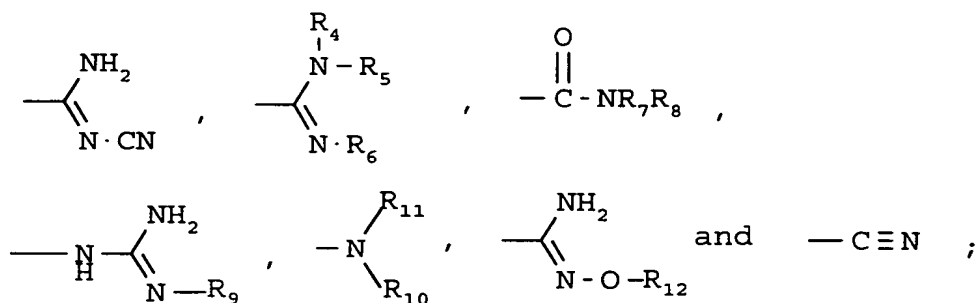
n is 3 or 4;

m is 1;

10  $R_1$  and  $R_2$  are hydrogen;

$R_3$  is chlorine or bromine;

B is selected from



15 wherein  $R_4$ ,  $R_5$ ,  $R_6$ ,  $R_7$ ,  $R_8$ ,  $R_{10}$ ,  $R_{11}$  and  $R_{12}$  are, independently from each other, hydrogen or methyl;  $R_9$  is hydrogen.

4. A compound according to claim 1 wherein the acrylamido moiety is directly linked to a pyrazole or imidazole ring.

20

5. A compound selected from the group consisting of:

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)-pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;

25

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;

30

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-

- carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propion-N-methylamidine;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propion-N,N'-dimethylamidine;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -chloroacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propion-N,N'-dimethylamidine;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propion-N,N,N'-trimethylamidine;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propionamide;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propion-N-methylamide;
- 2- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) ethylguanidine;
- 2- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -chloroacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) ethylguanidine;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido) propyl-N,N-dimethylamine;
- 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-

carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propioncyanamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N-methylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-N,N'-dimethylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-

carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido)  
propion-N,N,N'-trimethylamidine;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
5 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido  
propionamide;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
10 propion-N-methylamide;

2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
ethylguanidine;

15 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
ethylguanidine;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
20 bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propyl-N,N-dimethylamine;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
25 bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propionamidoxime;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
30 propionamidoxime;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-O-methylamidoxime;

35 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
chloroacrylamido)imidazole-2-carboxamido)pyrrole-2-

carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-O-methylamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
5 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propionitrile;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
10 propion-N-methylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
chloroacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N-methylamidine;

15 3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N,N'-dimethylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
20 bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N,N,N'-trimethylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
25 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N-methylamide;

2- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
30 ethylguanidine;

2- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
chloroacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
ethylguanidine;

35 3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-



carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propionamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrazole-5-  
5 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propionitrile;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)imidazole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
10 propioncyanamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)imidazole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N-methylamide;

15 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)imidazole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N,N-dimethylamine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
20 bromoacrylamido)imidazole-2-carboxamido)imidazole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-O-methylamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)imidazole-2-  
25 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propionitrile;

3- (1-methyl-3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrazole-5-  
30 carboxamido)propion-N-methylamidine;

3- (1-methyl-3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)pyrazole-5-  
carboxamido)propion-N,N'-dimethylamidine;

35 2- (1-methyl-3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-

carboxamido)pyrrole-2-carboxamido)pyrazole-5-  
carboxamido)ethylguanidine;

3-(1-methyl-3-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
5 carboxamido)pyrrole-2-carboxamido)pyrazole-5-  
carboxamido)propionamidoxime;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)imidazole-2-  
10 carboxamido)propion-N-methylamidine;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)imidazole-2-  
carboxamido)propionamide;

15 2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)imidazole-2-  
carboxamido)ethylguanidine;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-4-( $\alpha$ -  
20 bromoacrylamido)pyrrole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)imidazole-2-  
carboxamido)propionamidoxime;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-  
25 carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
propion-N-methylamidine;

3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
30 propion-N,N'-dimethylamidine;

2-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-  
carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)  
ethylguanidine;

35 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(1-methyl-3-( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)imidazole-2-

carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido)  
propionamidoxime;

3- (1-methyl-4- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) imidazole-2-  
5 carboxamido) pyrrole-2-carboxamido) pyrrole-2-carboxamido)  
propionitrile;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
carboxamido) pyrrole-2-carboxamido) propioncyanamidine;

10 3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
carboxamido) pyrrole-2-carboxamido) propion-N-  
methylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
15 chloroacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
carboxamido) pyrrole-2-carboxamido) propion-N-  
methylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
20 carboxamido) pyrrole-2-carboxamido) propion-N,N'-  
dimethylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
carboxamido) pyrrole-2-carboxamido) propion-N,N,N'-  
25 trimethylamidine;

3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
carboxamido) pyrrole-2-carboxamido) propionamide;

2- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
30 carboxamido) pyrrole-2-carboxamido) ethylguanidine;

2- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
chloroacrylamido) pyrazole-5-carboxamido) pyrrole-2-  
carboxamido) pyrrole-2-carboxamido) ethylguanidine;

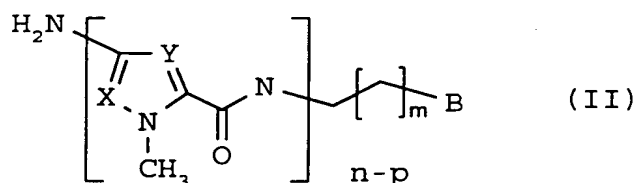
35 3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido) pyrazole-5-carboxamido) pyrrole-2-

carboxamido)pyrrole-2-carboxamido)propionamidoxime;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
chloroacrylamido)pyrazole-5-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propionamidoxime;  
5 3- (1-methyl-4- (1-methyl-4- (1-methyl-3- ( $\alpha$ -  
bromoacrylamido)pyrazole-5-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propionitrile;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
10 carboxamido)pyrrole-2-carboxamido)propioncyanamidine;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N-  
methylamidine;  
15 3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N'-  
dimethylamidine;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
20 bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N,N'-  
trimethylamidine;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
25 carboxamido)pyrrole-2-carboxamido)propionamide;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N-methylamide;  
2- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
30 bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)ethylguanidine;  
3 (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -  
bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-  
carboxamido)pyrrole-2-carboxamido)propion-N,N-  
35 dimethylamine;  
3- (1-methyl-4- (1-methyl-4- (1-methyl-4- ( $\alpha$ -

bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionamidoxime;  
 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(α-bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propion-O-methylamidoxime;  
 3-(1-methyl-4-(1-methyl-4-(1-methyl-4-(α-bromoacrylamido)imidazole-2-carboxamido)pyrrole-2-carboxamido)pyrrole-2-carboxamido)propionitrile; and the pharmaceutically acceptable salts thereof.

6. A process for preparing a compound as defined in claim 1, which process comprises:

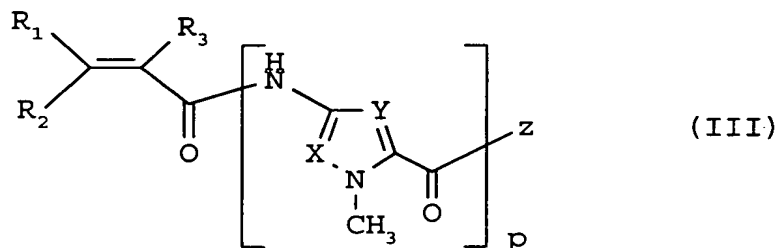
(a) reacting a compound of formula:



wherein n, m, X, Y and B are as defined in claim 1;

p is 0 or 1;

with a compound of formula:



wherein R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, X and Y are as defined in claim 1;

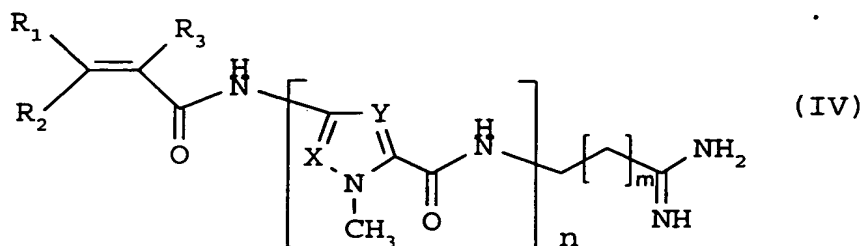
p is as defined above;

Z is hydroxy or a leaving group;

or:

(b) when B is equal to -C≡N, reacting a compound of

formula:



wherein n, m, R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, X and Y are as defined above;  
with succinic anhydride; and,

(c) if desired, converting a compound of formula (I) into  
5 a pharmaceutically acceptable salt thereof.

7. A process according to claim 6 wherein, in the  
compound of formula (III), Z is a group selected from  
chloro, 2,4,5-trichlorophenoxy; 2,4-dinitrophenoxy,  
10 succinimido-N-oxy and imidazolyl.

8. A pharmaceutical composition comprising one or more  
pharmaceutically acceptable carriers and/or diluents and, as  
the active principle, a compound as defined in claim 1.  
15

9. A compound as defined in claim 1 for use in a method  
of treatment of the human or animal body by therapy.

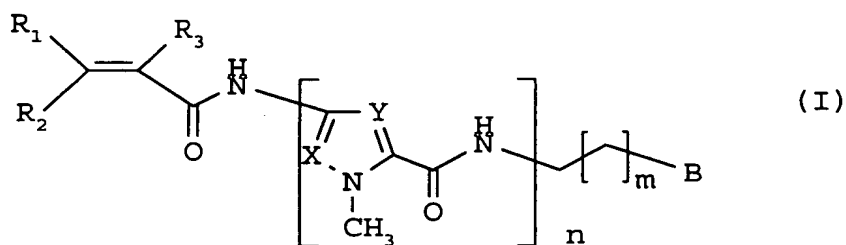
10. A compound as claimed in claim 9 for use as an  
20 antitumour agent.

11. Use of a compound as defined in claim 1 in the  
manufacture of a medicament for use as an antitumor agent.

ABSTRACT

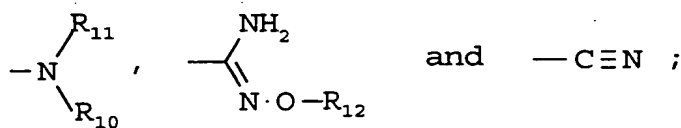
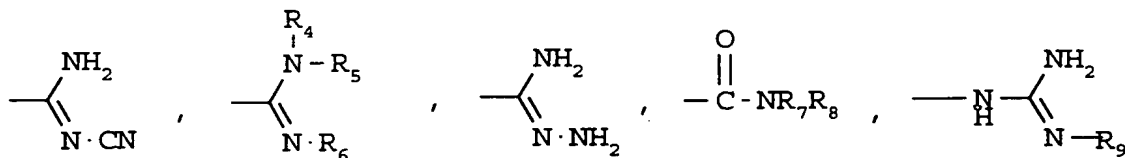
ACRYLOYL DERIVATIVES ANALOGOUS TO DISTAMYCIN, PROCESS FOR PREPARING THEM, AND THEIR USE AS ANTITUMOR AND ANTIVIRAL AGENTS.

- 5 Compounds which are acryloyl substituted distamycin derivatives of formula



wherein:

- 10 n is 2, 3 or 4; m is 1 or 2; X and Y are the same or different and are selected, independently for each heterocyclic ring of the polyetherocyclic chain, from N and CH; R<sub>1</sub> and R<sub>2</sub>, which are the same or different, are selected from hydrogen, halogen, and C<sub>1</sub>-C<sub>4</sub> alkyl; R<sub>3</sub> is hydrogen or halogen; B is selected from



- 15 wherein R<sub>4</sub>, R<sub>5</sub>, R<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, R<sub>10</sub>, R<sub>11</sub> and R<sub>12</sub> are, independently from each other, hydrogen or C<sub>1</sub>-C<sub>4</sub> alkyl; and R<sub>9</sub> is hydrogen or hydroxy; or pharmaceutically acceptable salt thereof; provided that a) at least one of R<sub>4</sub>, R<sub>5</sub> and R<sub>6</sub> is alkyl; b)  
 20 at least one of the heterocyclic rings within the polyheterocyclic chain is other than pyrrole; and c) X and Y are not both N for the same heterocyclic ring; are useful as antitumor agents.

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